Risk assessment of Landfills and their Impact of Surface Waters

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Risk assessment of Landfills and their Impact of Surface Waters

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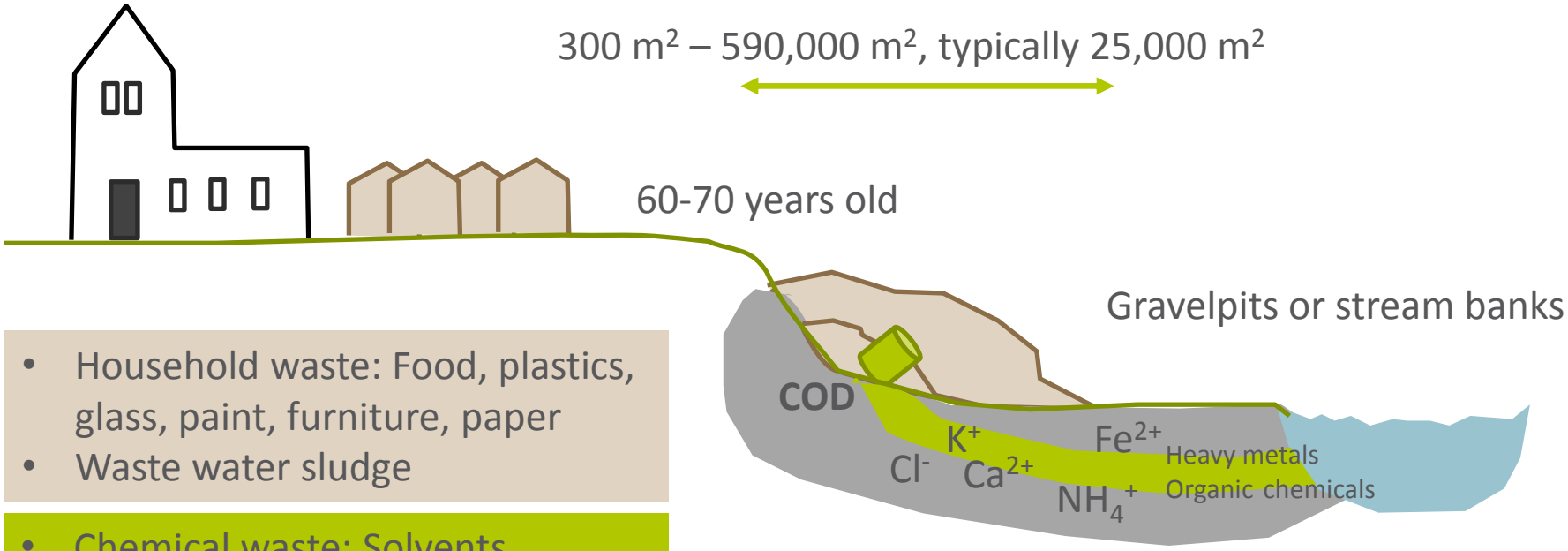
Background: Municipal Landfills



- Household waste: Food, plastics, glass, paint, furniture, paper
- Waste water sludge

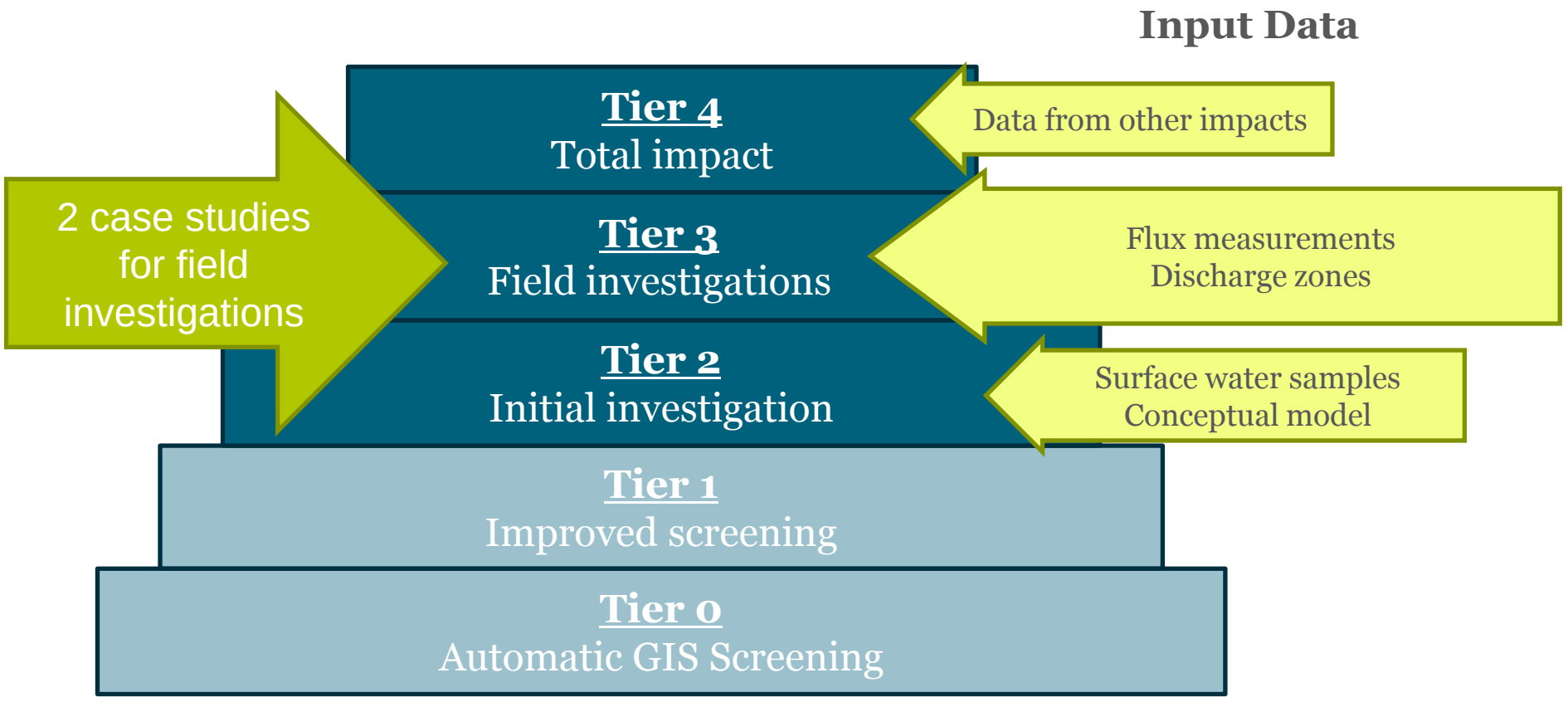
- Chemical waste: Solvents, gasoline, pesticide containers, batteries

Assumption:

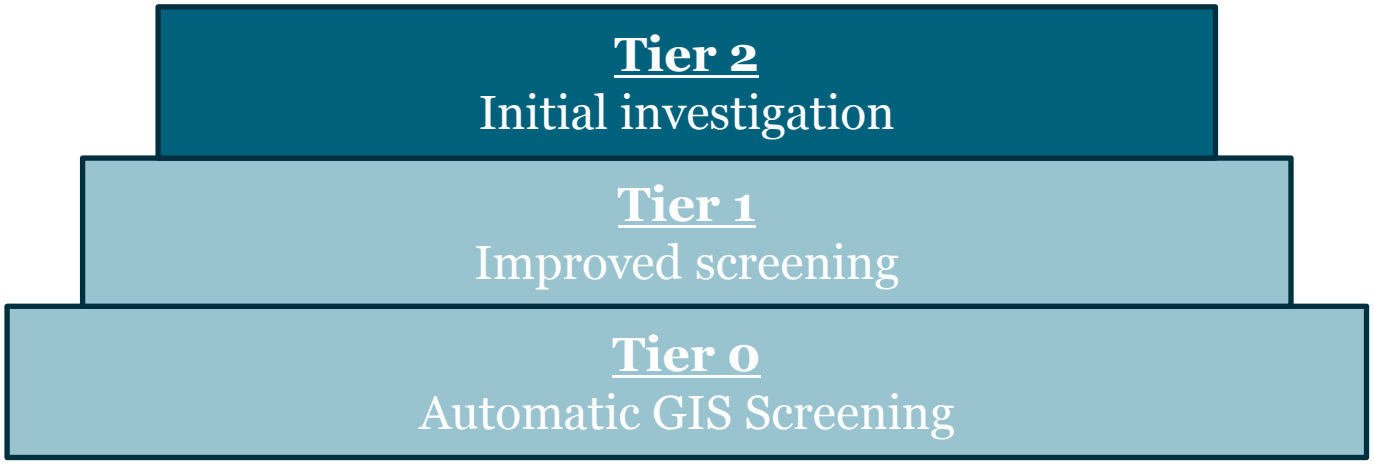
Old landfills are more likely than other contaminated sites to impact surface waters, particularly streams

Concept for Risk Assesment

Concept for Risk Assessment

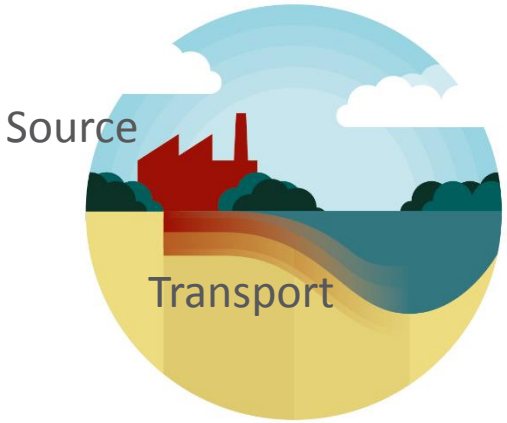


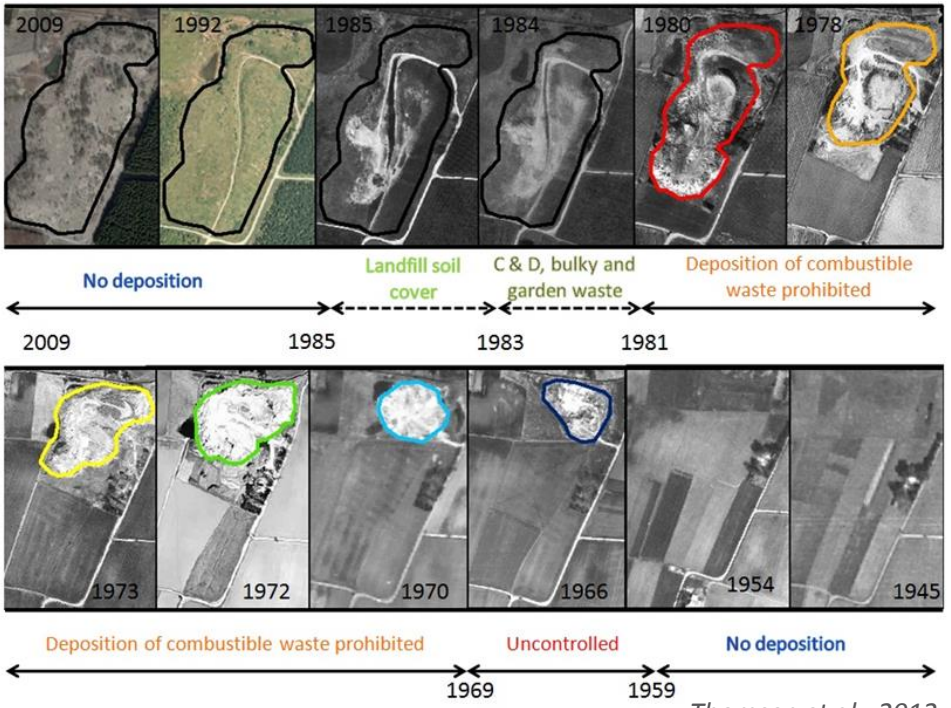
Tier 2:
Conceptual Model + Initial Sampling



Tier 2: Excisting data for conceptual model

- Source
  - Historical records, aereal photos, old maps ect.
  - Previous investigations: Wells, contaminants, concentrations
  - Geometry and site
- Transport
  - Groundwater and geology
  - Drain pipes
  - Surface run off
  - All part of conceptual model
- Receptor
  - Size of stream
  - Flow: discharge, temporal pattern

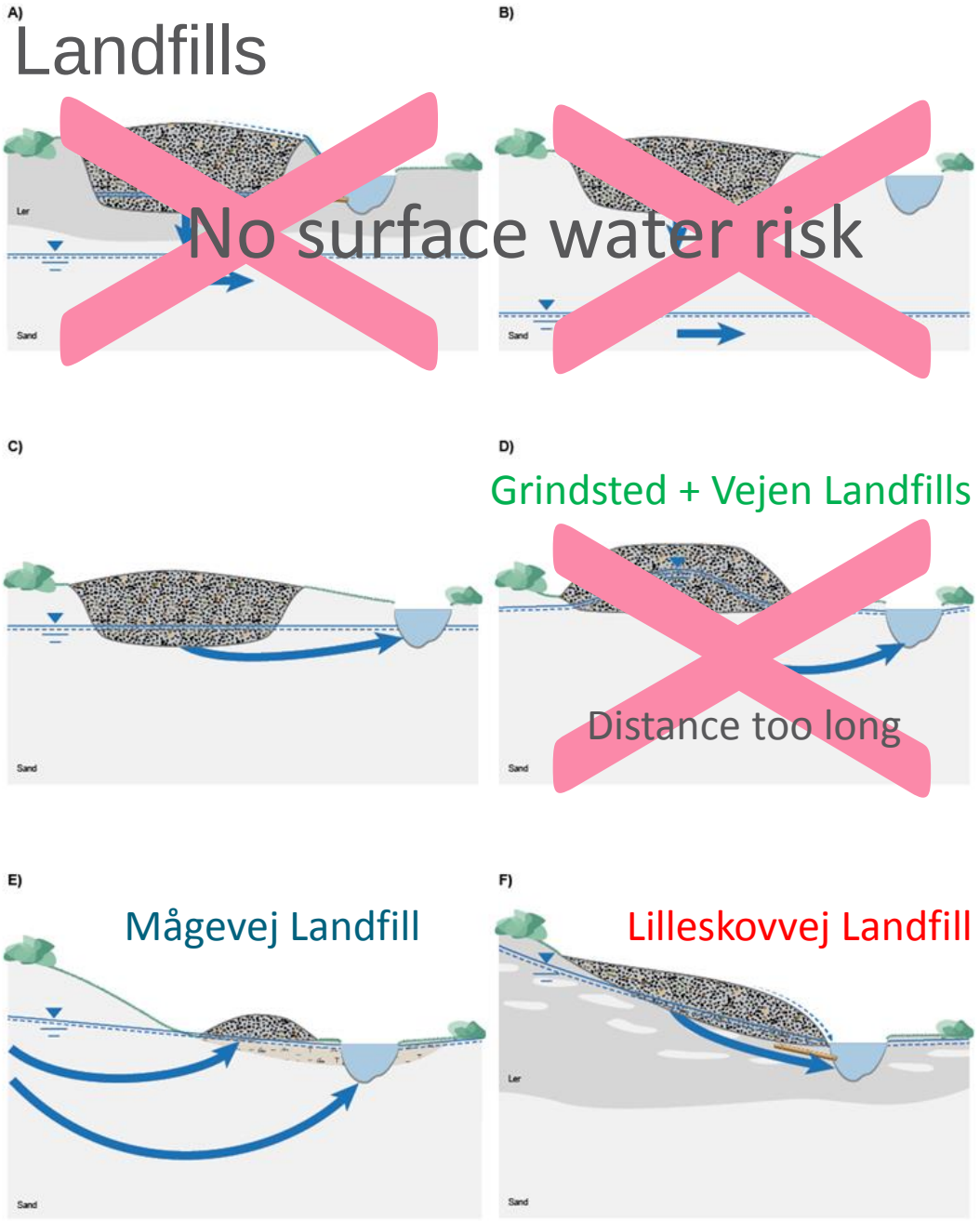




Thomsen et al., 2012

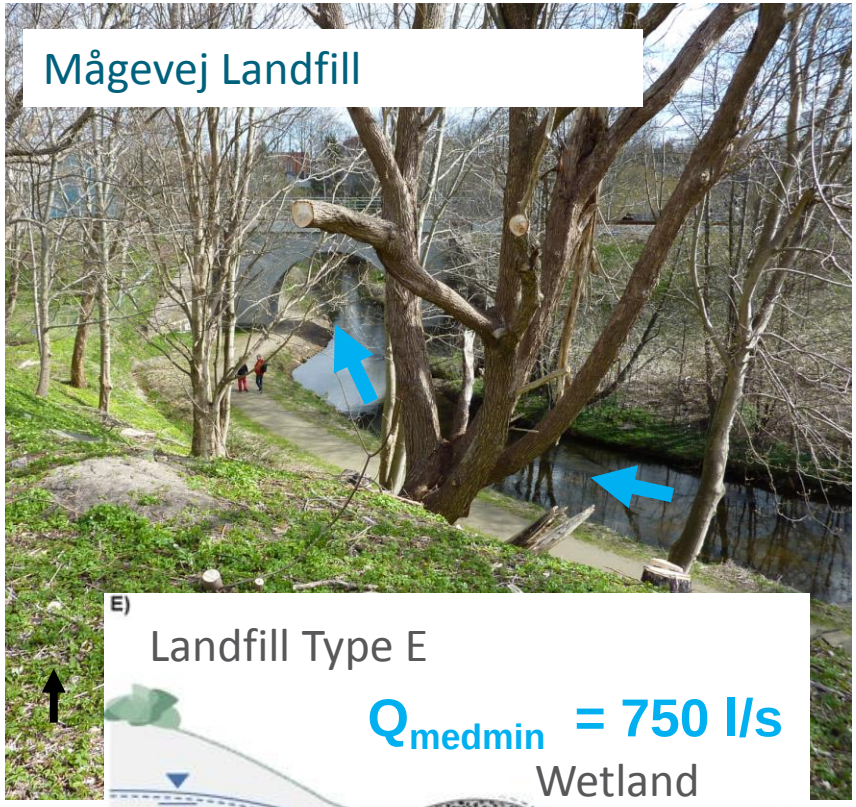
Conceptual Models for Landfills

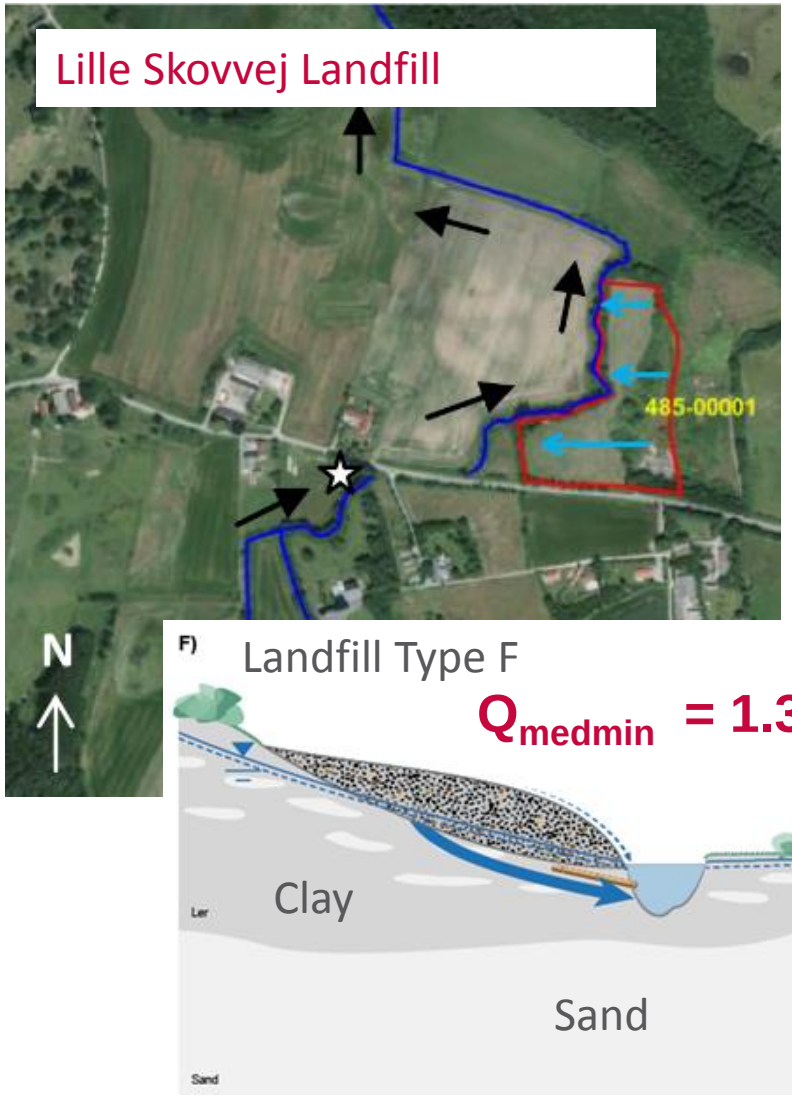
- Models describe leachate transfer pathway(s)
- Contaminant transport depends on
  - Shallow hydrogeology
  - Distance to surface water
  - Water table in waste?
  - Configuration of waste
  - Drain pipes



Inspired by:
Guide for contaminant investigations on landfills (AVJ)
GOI-typologies from Danish EPA

Tier 2: Conceptual models - Typologies



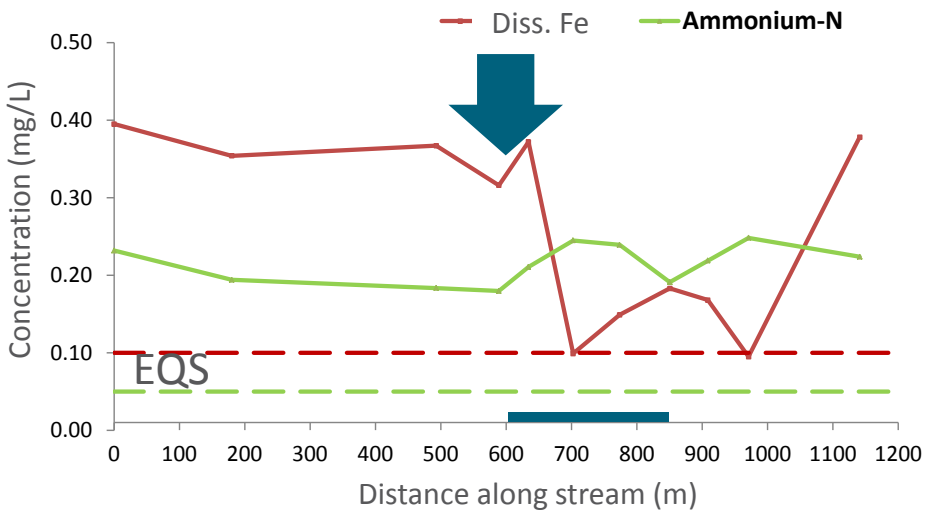


Tier 2: Initial sampling

- Why sample groundwater, when you can sample surface water?
  - Ground water sampling: Wells, pumps, risk of wrong placement, dry well …
  - Surface water sampling equiptment: Rubber boots
- Critical points:
  - Mixing in stream water
  - Several plumes or discharge points
  - Good conceptual model helps finding sampling point

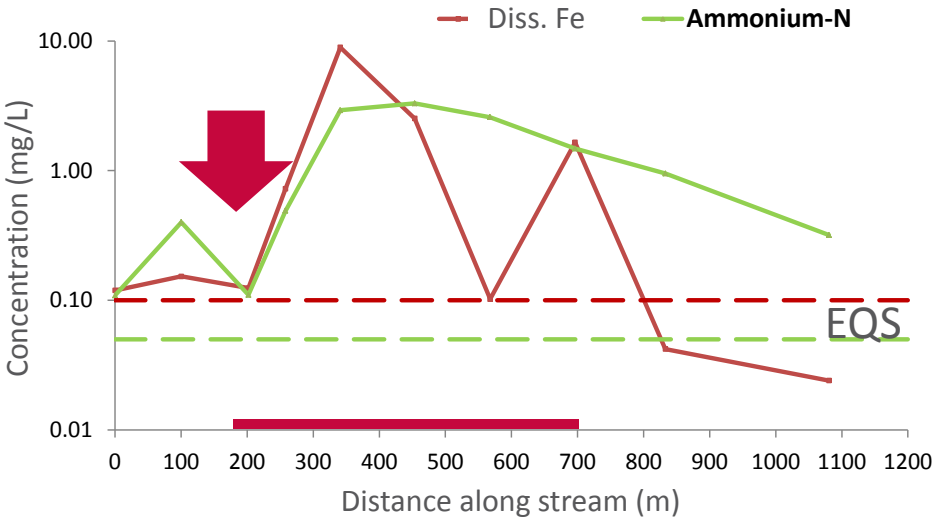
Ammonium and Dissolved Iron in Streams

Mågevej Landfill



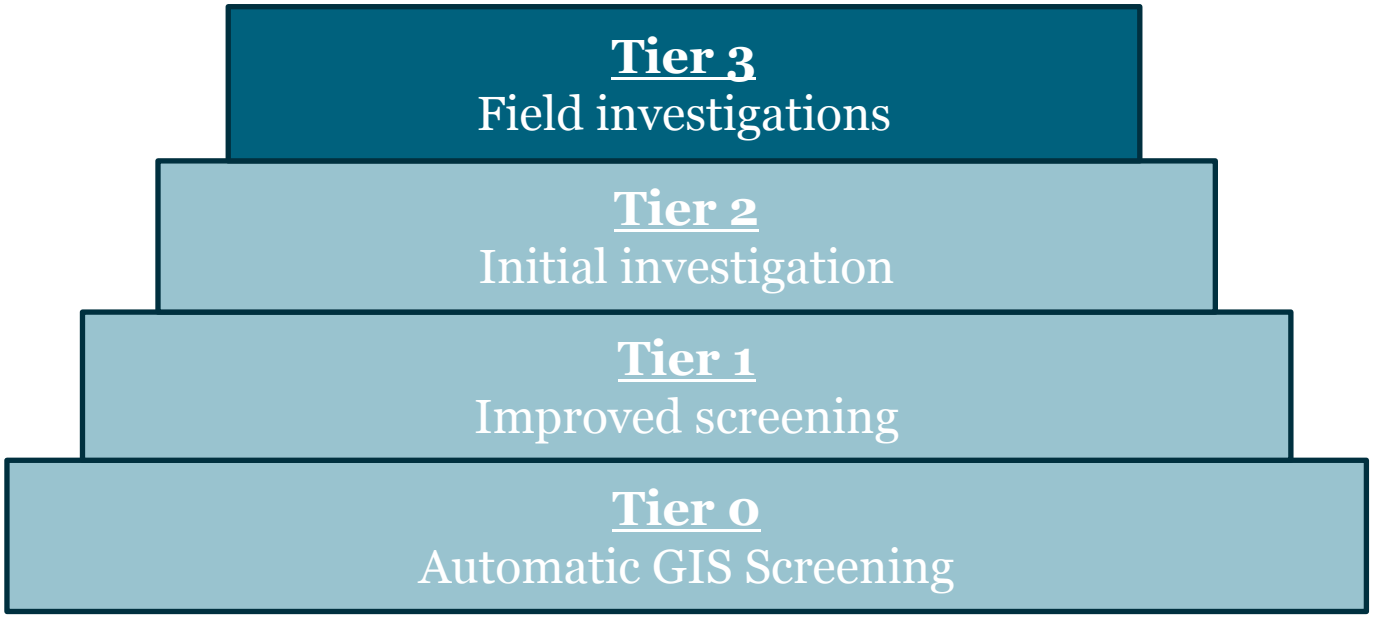
Ammonium level in stream exceeds EQS before landfill
Iron is possibly complexed

Lille Skovvej Landfill



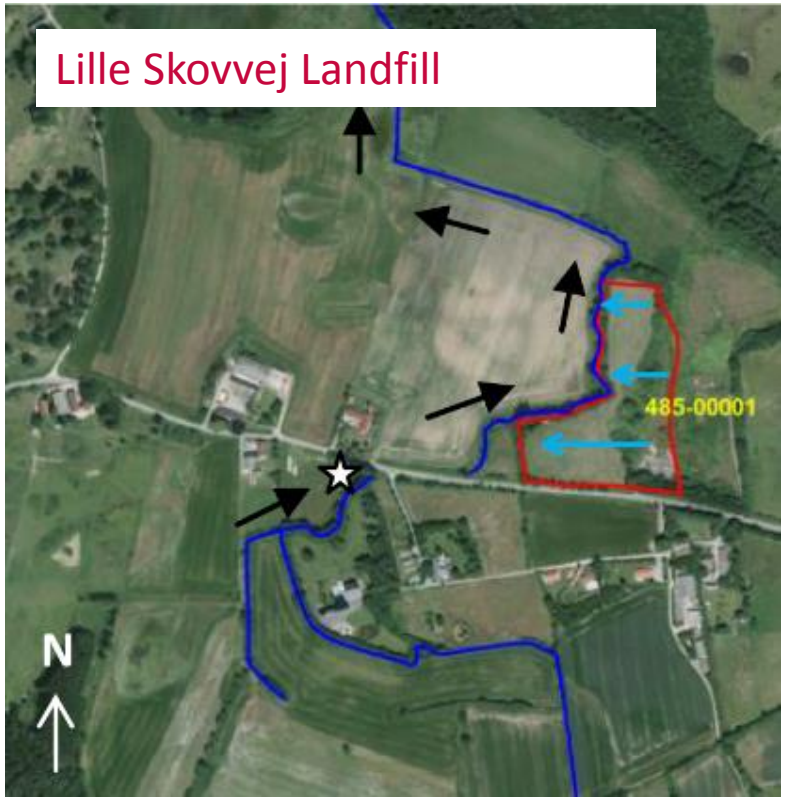
Ammonium level in stream ≈ EQS before landfill
Ammonium and Iron increases at landfill

Tier 3: Further investigations



Tier 3: Field Investigations

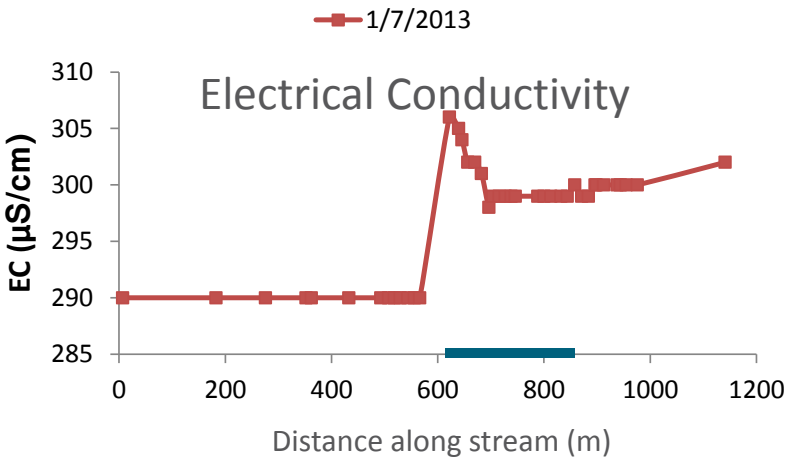
Q_{medmin} = 750 l/s

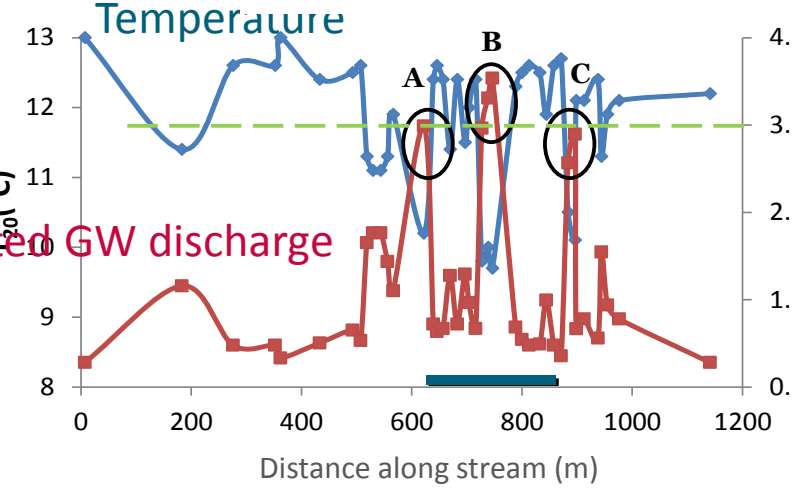


Q_{medmin} = 1.3 l/s

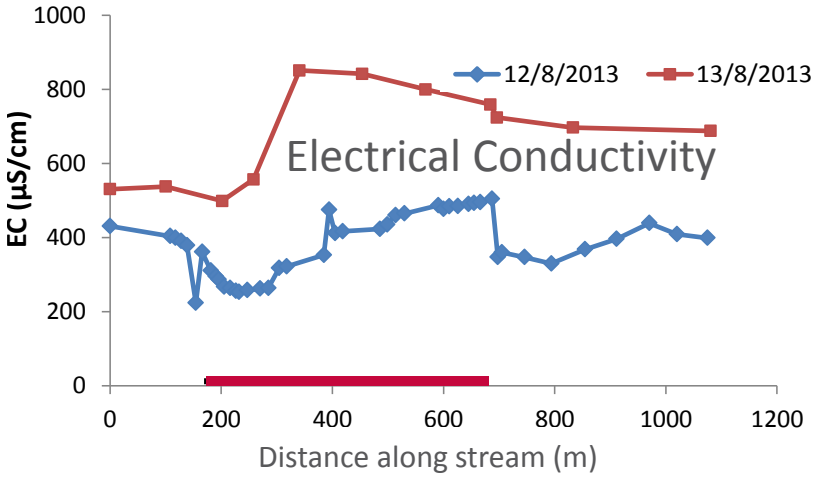
Tier 3: Discharge of Groundwater?

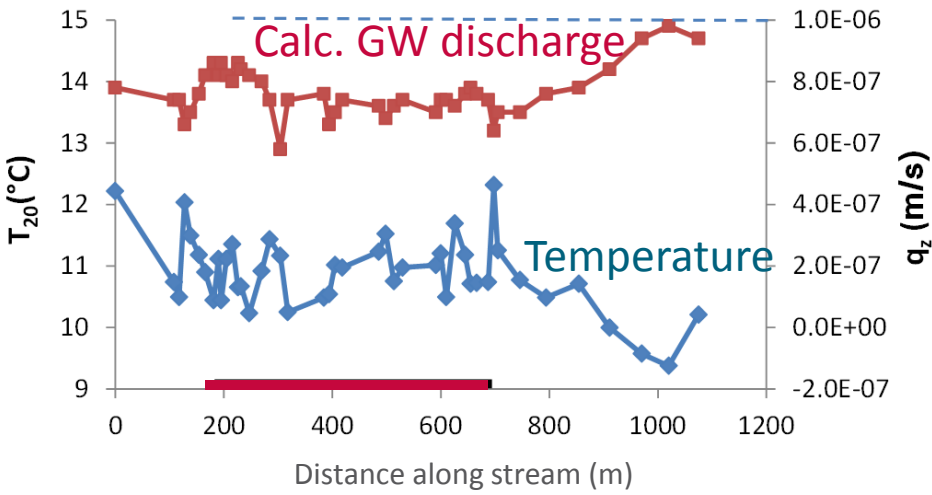
Mågevej Landfill





Lille Skovvej Landfill





Tier 3: Results from investigations

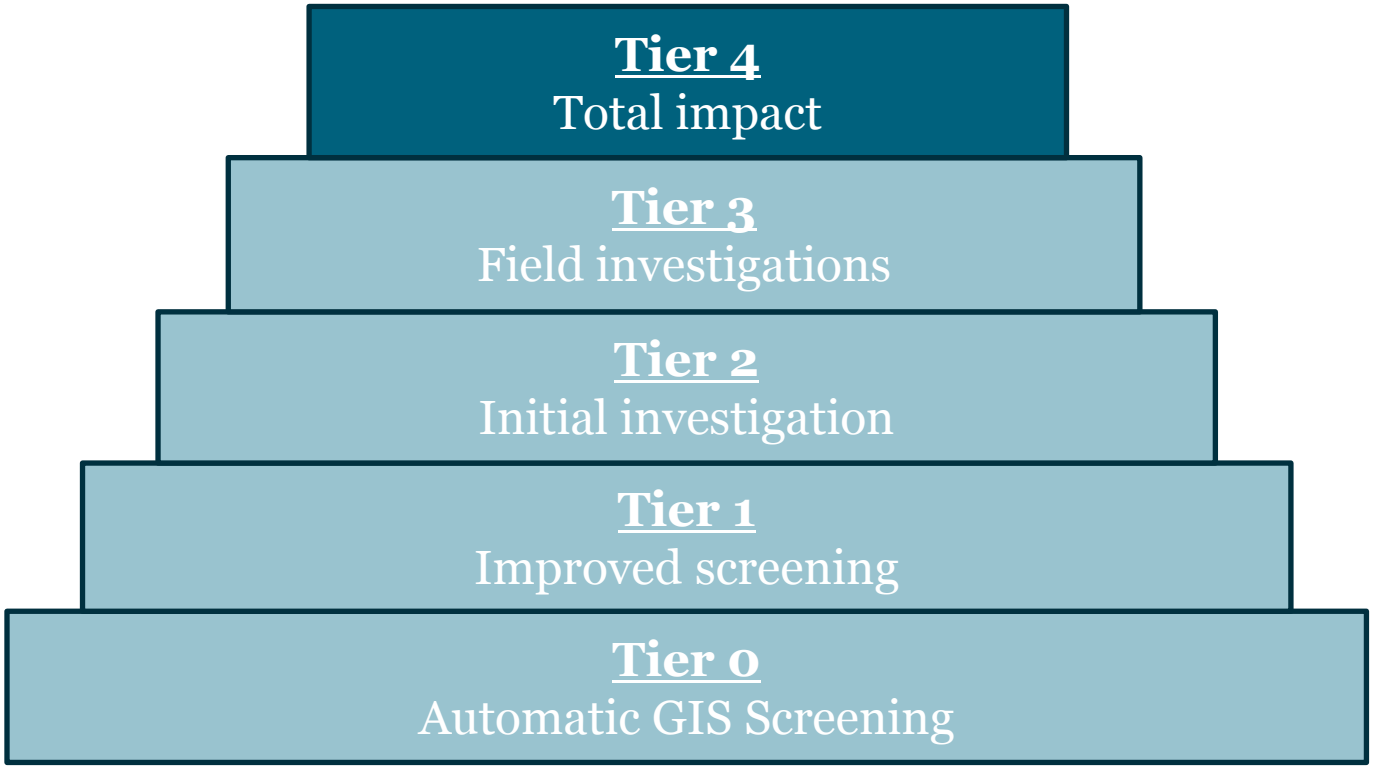
Mågevej Landfill

- Temperature and EC measurements: 3 discharge zones
- Discharge from sides of stream, not stream bottom
- Heavy metals and xenobiotics below detection limits in surface water and stream bottom
- Leachate (Fe, Ammonium, NVOC), above surface water criteria

Lille Skovvej Landfill

- Temperature measurements: No direct hydrogeologic contact
- Electrical conductivity shows clear leachate impact but with temporal variability
- Leachate (Fe, Ammonium, NVOC), heavy metals (Cd, As, Ba) and xenobiotics above surface water criteria way downstream landfill
- Most important pathway was drainage pipes, not groundwater

Tier 4: Total impact on water body



Tier 4: Total Impact on Water Bodies

- Chemical status: EQS
- Ecological status not considered so far. No direct measurements on ecology
- Consider the impact from other sources

Compounds	Other sources
Salts and chloride	Fertilizers Roads (de-icing) ”Clean” municipal waste water
Nitrate, NVOC, ammonium	Agriculture Aquaculture
Dissolved iron	Anaerobic groundwater Ochre formed by drainage
Xenobiotics and heavy metals	Waste water (municipal and industrial) Road run-off Contaminated sites?
Pesticides	Other point sources Washing stations Agriculture

Mågevej Landfill: *Insignificant impact*
Unknown sources of ammonium and iron upstream of landfill

Lille Skovvej Landfill: *Significant impact*
Not only lechate, but also xenobiotics, Ba, Cd and As

Conclusions

- Old landfills are important contamination sources which may deteriorate the chemical status of surface water bodies, mainly small streams
- Landfills are important co… …scale but not on catchment sca…
- Contaminants of conce… …OC, heavy metals and xeno…
- The tiered approach f… …s a useful tool developed for im… …of a complex contaminan…

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